

# Dynamic Quality Function Deployment in Higher Education

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## Abstract

Since no one has yet satisfactorily defined or measured service quality, the marketing of quality remains problematic. The system dynamics methodology helps crystallize the complex problem under study, and generate the scenario that is similar to a real-life problem. By changing dependent values, one can see into the future spectrum of a particular event happening. Also, the event's repercussions on all other parameters can be studied. Succinctly, system dynamics is a method for prognosis of an issue under consideration in all possible perspectives. This study seeks to review and examine some main models in service quality such as TQM and QFD and develops a new model for improving service quality using system approach in higher education institutions. Although QFD is one of the main methods for improving service quality but some problems such as fixed view into quality assurance make it inefficient. This study tries to develop a dynamic view for enhancing service quality, especially in higher education institutions.

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## 1. Introduction

Over the past few decades, industries have come to understand that in order to stay competitive globally, a self-assessment to continuously improve organizational performance is required (1, 2, 3, 4). Many researchers (5, 6, 7, 8, 9) feel that the principles of quality can definitely contribute to the improvement of higher education, in particular towards curriculum reform (10). There is a prevailing belief that higher education has entered a new environment in which quality plays an increasingly important role (11, 12). Service quality management (SQM) is a way of managing to improve the effectiveness, efficiency, cohesiveness, flexibility, and competitiveness of a higher education institution as a whole. Service quality has most often been defined in terms of customer perceptions. Hence, most of the conceptual frameworks that have been suggested for service quality are based on marketing concepts. Grönroos (13), in one of the first works to address service quality specifically, states that quality must be defined through the eyes of consumers, and thus must be perception-based. He presents a conceptual framework of service quality based on the service gap, the direct comparison of customers' expectations with their perceptions of the quality received. Much recent research on service quality measurement is based on this service gap concept. But this is not a comprehensive approach to service quality. In well-known models like QFD, a static approach to the measurement of service quality has been adopted; however, there are

dynamic relationships between the factors. This study seeks to appear the main service quality management models (measurement and improvement) in higher education in the last 2 decades and prove that current models in quality improvement are not efficient for their static view. Therefore, the purpose of this paper is to suggest and develop a reliable and valid model for measuring and improving service quality in higher education institutions.

## 2. HETQMEX

As defined by ISO 9004 (14), TQM is a management philosophy and company practices which aim to harness the human and material resources of an organization in the most effective way to achieve the objectives of the organization.

Because TQM is universal and proven by many successful firms, it should be used to formulate the mission statement for the services provided by HEIs; a generic mission statement could be: "To provide quality education, research and related services to continuously satisfy stakeholders' needs and achieve excellence through TQM" (15). The literature indicates that there is indeed considerable skepticism regarding the use of TQM in educational institutions. This skepticism revolves around a variety of issues. First is a lack of acceptance of the need for change. Ewell (16) contends that, even though there is substantial focus on the decline of America's education system, institutions do not always accept the need for change. Because the decline has been slow, the visible problems creep up and are accepted as the status quo. Without a strongly-felt need for change, real change is unlikely to occur. In order to overcome this complacency, Fisher (17) contends that strong, inspirational leadership is

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a must. This recommendation is consistent with Deming's call for leadership and constancy of purpose. In fact, many authors (18) cite leadership and top management support as key elements in TQM efforts. This argument could support TQM as both a valuable tool and a fad. If the vision of top management is consistent with the TQM philosophy and there is strong leadership, TQM can be a valuable tool. If TQM is being adopted as a quick fix without genuine, heartfelt support from the top, it is likely to go out of fashion with the newest buzzword. Recognizing a strong need for change will then be dependent on the selection of the organization's top executives. Another reason for skepticism is the threat to the faculty's individual autonomy. Operating as individual experts, faculties have been given extensive control over their courses. TQM's requirements of customer involvement and teamwork are viewed as a threat to this autonomy. This threat becomes very real when faculties and institutions have long operated under what is termed functional-silo syndrome. Functional-silo syndrome refers to the extensive specialization of many faculty members in narrowly-defined areas. Given that other faculty members and customers may not find these specialties of any value in the current business environment, these faculty members risk obsolescence. At the Third Annual Symposium on Quality in Action in Academe, this very issue was considered one of several key issues. The members of the symposium felt that, in order to implement TQM, faculty individualism would at a minimum need to be recognized. Godbey does not offer any advice on how to achieve this, but this stance is consistent with Deming's exhortation to drive out fear (19). TQM is that while it may improve existing processes, it cannot foster radical change. Fisher contends that by focusing on processes, and not people, there is no emphasis on individual performance. He also believes that TQM's current popularity supports this, since, if performance were at issue, fear would prevent its widespread adoption. Believing that radical change is needed, Fisher is skeptical as to whether a TQM organization will be able to sacrifice many of its sacred cows. He believes that the only way to effect radical change is through inspirational leadership. This aspect is of course consistent with TQM ideals. However, his argument against TQM seems to be founded in an organization that is gripped in fear. If fear can be overcome, his argument may no longer be valid. The last area regarding the application of TQM in educational institutions is its origin. The predominant examples of applied TQM come from manufacturing rather than the service sector (20). Although similar support functions, such as finance, facilities and purchasing, can be found in both manufacturing and service businesses, few models exist for applications within an academic system. Where TQM has been implemented in educational institutions, it is in its early stages so the model is just starting to take shape. University presidents also feel that implementing TQM is a big risk and only institutions that can afford to lose can take the risk of trying TQM. This is compounded by the fact that industry itself has not always achieved successful results with TQM (21). Universities have experienced this cycle before. Industry has adopted a new concept, pushed it on universities and then discontinued the support in industry. Without successful models in

academia and continuing support in industry, it may be difficult to maintain long-term support for the initial TQM vision. To maintain long-term support, it again appears that strong leadership will be a vital component in the TQM system. Summarizing the analysis above, a higher education TQM model of excellence is developed by Ho & Wearn (15) as shown in Figure 1. The HETQMEX model is almost self explanatory and can form the basis for services provided by TQM HEIs of the 1990s and beyond. HETQMEX provides a step-by-step improvement opportunity for HEIs which are committed to improving customer satisfaction through TQM. Dependent on the stage of quality development, particular HEIs can enter into any one of the seven stages. This is a gradual, ongoing, long-term rather than an immediate process, but worth the effort, resulting in sustained competitiveness. Satisfying customers is a continuous process because their requirements change over time. Thus, the desirable way to achieve total customer satisfaction is through continuous improvement via HETQMEX.

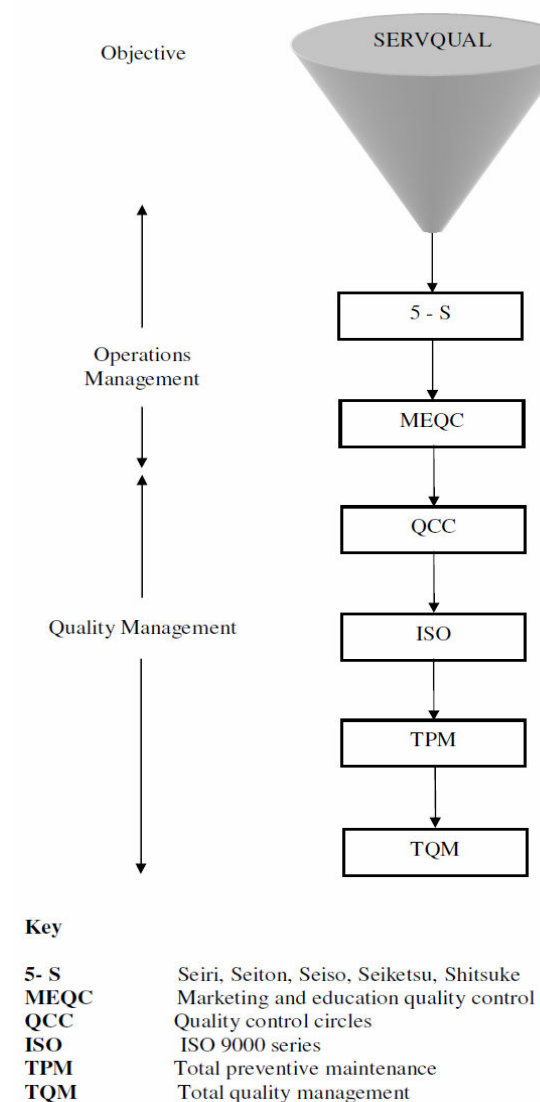


Figure 1. The HETQMEX model.

Based on this discussion, HEIs can embrace HETQMEX through a programme of training and implementation. The HETQMEX training and

implementation programme can be termed total quality programme (TQP) for an organization and is a unique approach for HEIs, to achieve excellence through TQM. Where certain HEIs have covered some stages of the model, they can tailor the programme to suit their own needs.

In order to implement the above objective successfully, the process is as follows:

- obtain top management commitment: most important of all establish implementation teams, including a quality steering committee and quality improvement teams;
- assess the current quality system situation to identify all the existing good practices;
- create a documented implementation plan – good project management is essential;
- provide training so that staffs are fully aware of the changes;
- create and update quality management documentation (BS 5750 or equivalent);
- monitor progress as part of the Deming cycle (plan-do-check-act).

### 3. HETQM Barriers

Venkatraman (10) reports that TQM remains a minimum global requirement for staying in business as dictated by changes in society and market. Yet, findings from TQM-related literature conclude that in many cases, TQM has failed to produce its promised results. Brigham emphasizes that the surveys do not conclude that the TQM philosophy is worthless rather suggests that the implementation of TQM has been deficient or erroneous. He states that the common mistakes made in implementing TQM in industry are lack of leadership, middle management muddle, misunderstanding of participation, obsession with process and failure to include the customer. He concludes that in higher education, TQM's long-term success depends on the lessons drawn from industry. Many researchers from higher educational institutions are still skeptical about adopting TQM in education (22, 23). Kohn has pointed out that before higher education jumps into another corporate bandwagon such as TQM, one should differentiate between education and business. He has expressed his concerns in the usage of metaphors by researchers while comparing education with industry. He emphasizes that in higher education, achieving high grades as a measure of success in implementing TQM is a major misunderstanding of the principles of TQM. Therefore, the first major barrier for the application of TQM in education is the misinterpretation of TQM philosophy and the lack of understanding the processes that are different in education as compared to industry. This could be due to lack of the necessary knowledge about TQM. A common barrier to both industry and education in implementing TQM is lack of proper leadership (Brigham, 1993). Leaders should be able to set viable corporate vision and be willing to initiate change and provide the resources needed for team efforts directed towards achieving the vision. Senior management may want the results, which TQM can bring but may not be backing it wholeheartedly. TQM should be embraced as a strategy by the top management and they should get visibly and explicitly committed to its philosophy. Another barrier could be employees' resistance to change. In the

case of higher education, most of the employees are predominantly professionals who by tradition expect autonomy and academic freedom. Academic staff may not like being asked to rethink their teaching styles. Educational professionals may be more devoted to teaching than to TQM. Further, it is a common belief that TQM adds unnecessary layers of bureaucracy (24) which is not a preferred domain amongst academic professionals. Hence, it may not be possible for them to adopt TQM principles in a short span of time. The final barrier for implementing TQM in higher education could be lack of sufficient funds and resources. TQM involves a paradigm shift in the mindset of the entire organization. This can be achieved through systematic and strategic training of all the employees. The educational organisation may not have the required expertise to train the staff and may look for external consultants for training, especially to suit the requirements of education. Hence, TQM involves high cost, effort and time. Since educational institutions predominantly receive funds from the government, TQM may lead to overshooting of costs. With such immense financial and resource considerations, TQM may not yield the expected benefits within a specific time frame.

### 4. HEQFD

In 1972, Mitsubishi Heavy Industries first applied QFD in Kobe Shipyards. Since the 1980s it has found widespread acceptance in US industry as an effective tool for attaining high quality. The fundamental idea of QFD is to translate the VOCs (customer requirements) into the final product and/or service quality. The whole translation process can be considered in stages, for example:

- From customer requirements to product features;
- From product features to design requirements;
- From design requirements to process requirements; and finally;
- From process requirements to processes/methods (25).

The final processes/methods, if carried out properly, should produce the product/service that meets the original customer requirements. The translation process uses a series of matrices, commonly known as the house of quality (HOQ) as shown in Figure 1, to study and analyze the relationships, the importance, and the trade-offs between various factors (requirements). A detailed discussion of the general and conventional methodology and principles of QFD and HOQ may be found in Hauser and Clausing (26). As Bossert (27) succinctly put it:

The power of QFD is in its founding philosophy: the voice of customer will drive everything an organization does throughout the process of developing and delivering products and services. Hwang & Teo (25) report that since the early 1990s, there have been a number of QFD applications in higher education. We may classify these applications into three broad categories, namely, teaching effectiveness, curriculum design, and others. The first category focused on using QFD to improve teaching effectiveness and customer satisfaction. Clayton (28) reported using QFD coupled with process analysis to provide cost-effective, high-quality lifelong learning for optometrists-to-be at Aston University. Jaraiedi and Ritz (29) applied QFD to explore ways to improve advising and teaching processes at West Virginia University. Lam and

Zhao (30) used a technique called the analytical hierarchy process (AHP) together with the QFD correlation matrix to evaluate the effectiveness of teaching at the Department of Management Science at the City University of Hong Kong. Motwani et al. (31) described a three-house approach using American Assembly of Collegiate Schools of Business (AACSB) accreditation requirements as key considerations for designing the MBA programme at Grand Valley State University. The outcome of the final house indicated teaching pedagogy, and topic coverage, among other things. This, however, was not directly resulted from the translation of the VOC; rather, it was anchored on AACSB's requirements. Pitman et al. (32), of the same university, also used QFD to evaluate their MBA programme by measuring customer satisfaction.

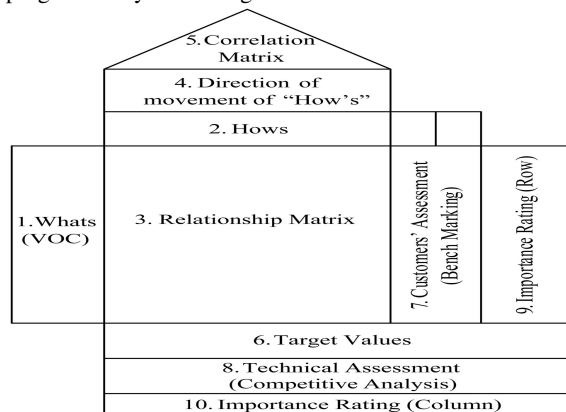


Figure 2. HOQ.

The second category was devoted to the design of engineering education and curricula using TQM and QFD principles (33). Seow and Moody (34) concentrated on identifying the VOC to improve the curriculum development process at the University of Portsmouth. Benjamin and Pattanapanchai (35) illustrated how they had applied QFD principles and software to prioritize their planning objectives for developing engineering laboratories at the University of Missouri-Rolla. Koksai and Egitman (36) used QFD in conjunction with AHP to identify general design requirements, with no mention of specific requirements, for the Industrial Engineering programme at the Middle East Technical University. Similarly, Owlia and Aspinwall (33) applied QFD principles to identify broad categories of processes relevant to quality characteristics. They also highlighted the different perceptions by students, staff, and employers. Krishnan and Houshmand (37) used QFD to address customer requirements in the design of engineering curricula at the University of Cincinnati.

Other applications are grouped in the third category. Chen and Bullington (38) reported their application of QFD in research strategic planning. Their focus was on the identification of strategic research directions. Though specific steps and general phases of the QFD process were described, no house of quality was presented and the approach was rather informal. At the strategic level, Chang and Ku (39) employed TQM and QFD principles to highlight potential improvements to the engineering and technical education in Taiwan.

They emphasized the importance of satisfying the students' needs for education as well as the industry's needs of manpower. Treating faculty, students, and

industry as the customers respectively, Ermer (40) showed the design requirements needed to satisfy each group of customers at the Department of Mechanical Engineering, University of Wisconsin-Madison. The results seemed to demonstrate QFD's utility in process improvement and cycle time reduction in an academic setting. Also looking at the broader aspects of higher education, Akao et al. (41) presented multiple matrices, e.g. society vs students, student's vs university education, and society vs university education, showing the relationships between the VOC and design requirements. They evaluated quality from both internal and external customers' viewpoints.

## 5. Customers of Education

In a service industry, a customer is anyone being served. Customers may be both internal and external, depending on whether they are located within or outside the organization. Quality starts with customers and is defined by customers. So one must obviously be able to identify one's customers, to be able to meet their needs and satisfy them. Since quality is what the customer says it is (42), product and service quality managers must identify customer requirements and strive to meet and exceed them. In education, this is not necessarily simple. Students, staff, faculty, organizations, parents and society – all have a stake in the quality of education being delivered by educational institutions. Madu et al. (42) have classified customers into input customers, transformation customers and output customers. Parents and students can be classified as input customers, faculty and staff as transformation customers and corporations and the society constitute output customers. Kanji et al. (43) have classified customers of higher education into primary and secondary groups on the basis of their locations i.e. whether internal or external, and the frequency of interactions the institution has with them. While the educator (as an employee) is the primary internal customer, the student (as an educational partner) is the secondary internal customer. The student is also the primary external customer and his/her parents and recruiting organizations constitute secondary external customers. Thus, higher education has a number of complementary and contradictory "customers". Nevertheless, it is essential that customers be identified and processes be established in order to determine specific needs and maintain customer-oriented service (44).

## 6. SDQ: a New Approach in Higher Education

According to Forrester's approach, in about 1960 there is a change in the nature of management and leadership. In the past, management was seen as an art and taught as an art. Art is developed by empirical experienced but further development shows saturation behavior; the growth speed is declining because of unorganized knowledge (45).

In the area of management science, Forrester developed a new concept, 'industrial dynamics' (45), later also called 'system dynamics'. 'System dynamics' investigates how strategy, decision-making, structure and delay influence the growth and stability of an organization. The goal is to create more successful management policies and

organizational structures (46). SD uses a six steps process for improvement as below:

1. Define the problems to be solved and goals to be achieved.
2. Describe the system with a causal loop/influence diagram.
3. Formulate the structure of the model, i.e. develop flow diagrams and associated mathematical models that represent rates of change through different interactions.
4. Collect the initial data needed for operation of the model like historical data
5. Validate the model using appropriate criteria to establish sufficient confidence in the model.
6. Use the model to test various actions to find the best way to achieve prescribed goals.

### 7. Dynamics of Service Attributes

Already in the 1950s, researchers within the so-called Copenhagen School introduced the parameter theory, which included a marketing mix that was related to the product life cycle. Gosta Mickwitz, one of the researchers in the Copenhagen School, argues that different marketing instruments have different elasticity in different phases of a product life cycle. He suggests that quality has the largest impact in the introduction phase of a market, while service, i.e. maintenance and repair, has the smallest impact.

In an empirical investigation of the use of cellular phones, Johnson et al. (47) describe how, during the early growth phase of a market, performance has the highest impact on customer loyalty, but over time this effect decreases and the influence of constructs such as brand and relationship on loyalty becomes stronger. In addition, Johnson and his co-authors suggest that performance does not help in building relationships and image until an organization has, over time, maintained a certain level of performance in the eyes of the customers. Using a multi-attribute approach for evaluating customer satisfaction, Mittal et al. (48) investigate how the performance of different attributes that maximize customer satisfaction varies depending on the customer's goal fulfillment. Hence, satisfaction here is not directly linked to performance of attributes, but to attributes' varying contribution to goal fulfillment. That is, the more precise an attribute is for the goal fulfillment of a customer, the higher the satisfaction. An interesting observation in their study within the automotive industry is that the exterior styling of a car had a higher ranking before than after the purchase of the car. Their study indicates that the exterior styling is no longer a salient attribute when it comes to judgment of satisfaction. For example, the styling of the car becomes less important if the engine is leaking. The styling does not change after the purchase, yet it was even more important before the purchase when this attribute among others led the customer to buy a brand-new car. In a similar context, Mittal et al. (48) show that the relative importance of service and product attributes change over time. In addition, Mittal and Katrichis (2001) found that newly acquired and loyal customers of a firm put different importance on the same attribute.

Woodruff (50) describes how customer perceptions of value are time-dependent. He explains customer value as

the emotional bond between the customer and the producer after using the product. This theory maintains that the attributes that are important to the customer change over time. The attributes that make the customer decide to buy the product are not the same as those that are perceived to be important during the use of the product. Based on Woodruff's ideas, Parasuraman (51) suggests that customer value is a dynamic concept because both the choice and magnitude of attributes that customers use to judge relative importance are likely to change over time. By investigating the relationships between service attributes and customer satisfaction in different phases of a market (47), the consumption process (48) and a customer relationship (49), research suggests that service attributes, customer satisfaction, customer value, loyalty, brands and relationships are all dynamic. In addition, Oliver (52) and Mittal et al. (48) suggest that different kinds of attributes have different relationships with customer satisfaction; these can be linear or asymmetric. As suggested by Mittal et al. (48), an important issue to investigate is whether and how these asymmetries vary systematically over time. Mittal and his colleagues describe how an attribute that is utility-enhancing during the initial consumption period might become utility-preserving over time (53).

### 8. Developing a New Model using SD

Unfortunately, the move to institute more quality in services greatly outstripped action in the realm of service quality. The failure to measure and control service quality may have been caused by two factors. First, the intangibility of most services is problematic since it can cause measurement difficulties and make research results unreliable. Service quality perceptions may vary a great deal across any given set of observations; while this could be related to actual variance in service performance, the difficulty of perceiving relatively intangible end results may also be at fault.

Second, service quality is considered by some to be impossible to model. That is, because so many factors affect an individual's perception of service quality, some researchers have found it difficult to isolate causal factors and draw any meaningful conclusions as to what influenced service quality ratings.

According to author's experience, there are two major problems and limitations in QFD model.

1. Excessive customer needs (VOC) that is very difficult for translating into service elements (How).
2. Lack of an exact procedure for predicting of improvement in meeting customers needs. In the current QFD model, for example we can calculate a need for 18 percent improvement in quality; but there is not an exact procedure and time for achieving to this goal.

Summarizing the analysis above, a model of excellence is developed by the authors as shown in Figure 3. This model provides a step-by-step improvement opportunity for HEIs. As shown below this process have 4 main steps:

1. Gap analysis of students perception and expectation
2. Identifying the excitement, performance and basic needs and placing basic needs as VOCs in QFD. This step eliminates some needs with lower importance.

3. Doing QFD. This step translates VOCs into service element, but there is no prediction for understanding degree of improvement in a period.
4. Prediction of improvement in meeting customer needs. As we can see in figure 3, for example 4 VOCs and 7 service elements were identified. The relationship between each SE and VOCs appear in relationship

matrix of QFD. For understanding relationship between each SEs, we have to use correlation matrix at the roof of HOQ.

Using a system dynamics approach we are able to perceive any improvement in VOCs in any time. In the early future, we will examine the model efficiency in Yazd University.

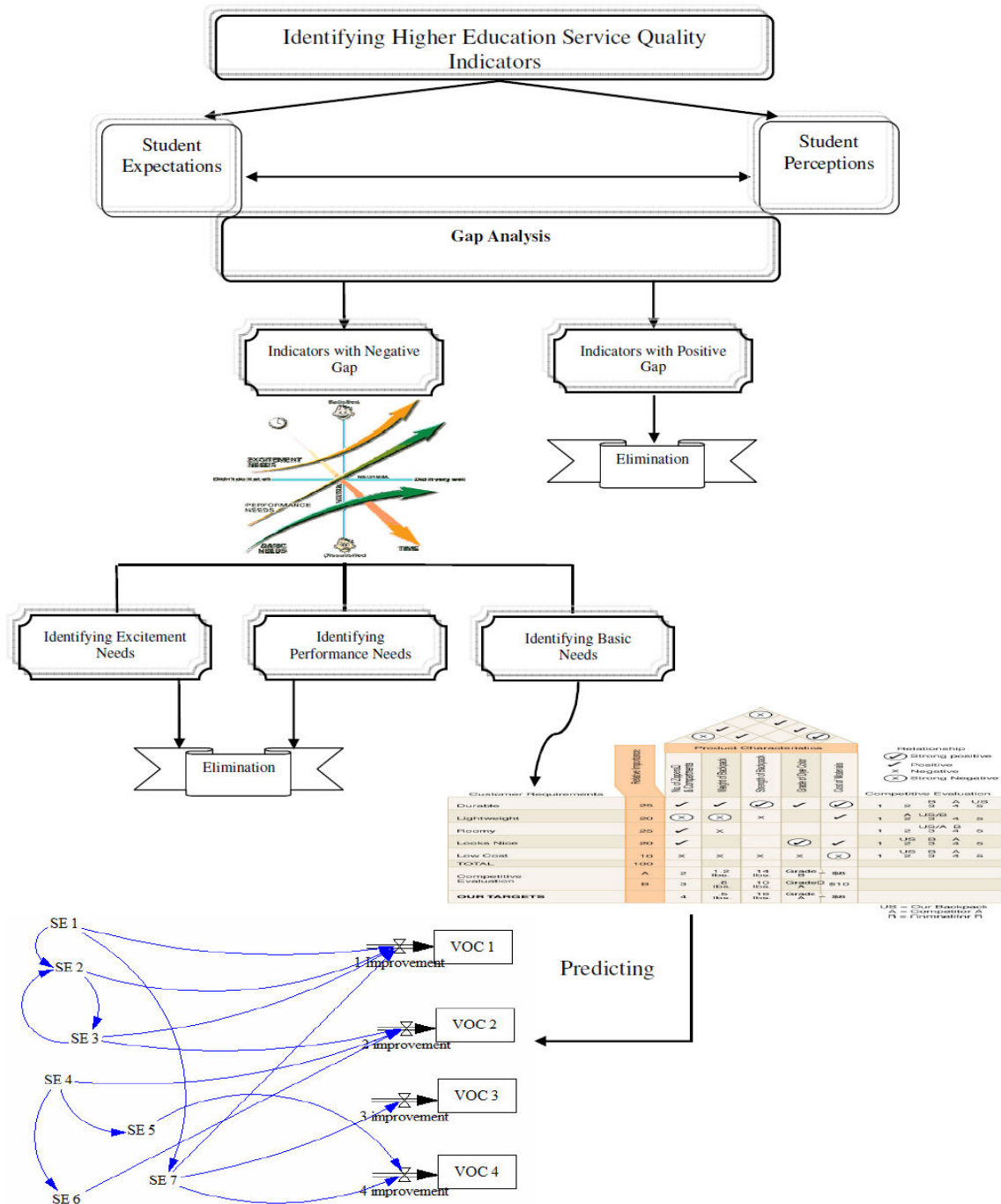


Figure 3. A new model for meeting customers needs.

## 9. Conclusion

While higher education institutions are the home for learning and create knowledge through their research function, it is ironic that they have been lagging behind other organizations in embracing and implementing QM. This inertia in the adoption of QM seems to be due to certain structural and traditional characteristics of higher education institutions. There are also some special challenges that are not encountered in other organizations. Some of these characteristics which cause difficulties in QM implementation are discussed in this article.

There are new approaches like SD help to providing a QM structure for HEIs. System dynamics supports ideas of human relations movement as the comprehensive system approach of TQM and business excellence. Only appreciation of a complex, dynamic system enables managers in turbulent days to manage in a comprehensive way and to decide and act for long-lasting success. So, this article demonstrates the advantages and barriers of TQM, QFD and system dynamics and how these models can be effectively and efficiently applied in HEIs, as illustrated by a new developed model.

Being able to measure all dimensions relevant to service production is essential for a service model. With customers interacting with the service provider and being an integral part of the service production, the need to measure the customers' perceptions of all three aspects of the service is apparent. Just as essential is the ability to distinguish these aspects from each other and to evaluate them separately. This is because the company may be performing well in one area but not in another. By using distinct measures, firms can identify the most appropriate action and resources can be allocated more efficiently along the production process. The view of the whole picture

will not, however, be sacrificed by focusing on any specific attribute of the service.

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